

Electron diffraction on boron nitride nanotubes

Scientific Achievement

We recorded the first intensities of electron diffraction patterns (EDP) from individual nanotubes (single-, multi-walled) as well as from bundles of boron nitride nanotubes (BNNTs). Helicities have been systematically measured and the diameter of the NTs has been obtained in most cases. For single-walled and double-walled nanotubes we deduced the chiral indices using the kinematical electron theory to simulate the EDP of the tubes. We have not observed any difference between the EDP of a BNNT and that of a carbon nanotube. The analysis of the ED data revealed that 12 % of the BNNTs are zig-zag, while the distribution of the other helicities is uniform. It is likely related to the catalytic growth of the tubes. This conclusion is in good agreement with our previous high resolution transmission electron microscopy studies and existing theoretical work. Furthermore, we observed a difference of the chiral angle between the independent tubes of ropes containing only two tubes and that of double-walled NTs, which suggests a different interlayer interaction of these BNNT configurations that is probably related to their formation.

Significance

Boron nitride nanotubes are an emerging nanomaterial that complements the popular carbon nanotubes. BN tubes are insulators with a constant band gap >5.5 eV, independent of their helicity and diameters. These tubes can be used for high-power-high-frequency electronic devices; they also have outstanding mechanical properties, are chemically inert, and can function as protective cages in the nanoworld. Detailed knowledge of the atomic structure of these nanotubes (chiral angle and diameter) is a fundamental question to understand of their growth mechanism. The most reliable technique for obtaining this information from the nanotubes is electron diffraction. Our results show for the first time the EDP of a SW- and DW-BNNT, providing us rich information concerning their atomic.

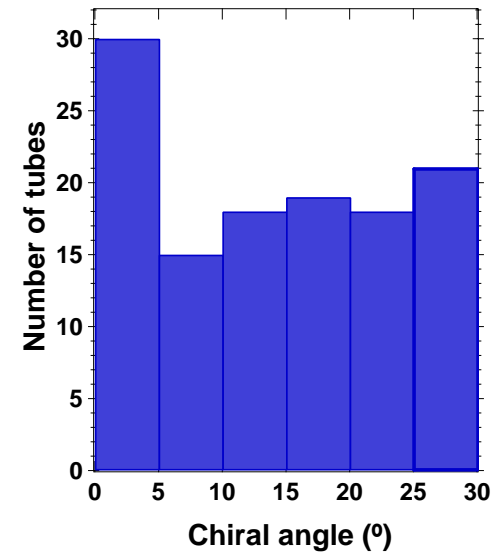
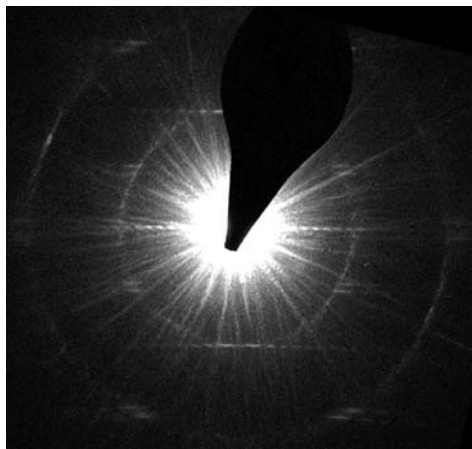
The future applications of these materials require huge quantities of long NTs. The use of ropes of NTs could solve both points. We will focus then, in the analysis of the EDP of these ropes of BNNTs. Due to the structural configuration of these objects, this kind of analysis is more complex than for single-walled and double-walled BNNTs. Nevertheless this information is very important to enable a better understanding of their growth and of the interactions between the BN networks.

Performers

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Electron diffraction on boron nitride nanotubes



A detailed knowledge of the atomic structure of BNNTs is key to understanding their growth mechanism. Electron diffraction is the most reliable technique to obtain this information from the NTs.

We recorded the first electron diffraction patterns (EDP) from a series of single- and multi-walled individual NTs and also bundles of BNNTs. We deduced the chiral indices using the kinematic electron theory to simulate the EDPs of the tubes.

The future applications of these materials require huge quantities of long NTs. The use of ropes of NTs could solve both points. We will focus then, on analyzing EDP of ropes of BNNTs to enable a better understanding of their growth and of the interactions between the BN networks.